Simple decision tools to help optimize the control strategy 2 weeks into a Danish FMD epidemic

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A simple decision tool to help optimize the control strategy 2 weeks into a Danish FMD epidemic

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The choice of whether or not to apply emergency vaccination is one of the most difficult decisions facing the authorities when foot-and-mouth disease (FMD) breaks out in a free country (Barnett et al. 2002). A simple quantitative tool has been proposed using the first 14-days incidence (FFI) of outbreaks by 12 regional foci in the 2001 UK epidemic to predict the duration and the cumulative number of outbreaks at the end of the epidemic (Hutber et al. 2006).

Contingency planning should include provision for emergency vaccination and must address the complex decisions of not only when, where, and how to apply vaccine, but also its economic consequences. Computer modelling may be a useful aid to cost benefit and decision support systems in this context (Barnett et al. 2002). We used a modified FFI procedure to analyze data from a series of 5,000 FMD simulations with current Danish population data at the national level and the basic EU control strategy using a modified DADS model (DTU-DADS).

The primary independent variable in regressions and correlations was the number of outbreaks detected during the first 14 days of the epidemic. The dependent variables were the number of outbreaks detected after day 14, the epidemic duration after day 14 and the size of the affected region at the end of the epidemic.

Statistically significant positive correlations were found in all regression analyses of the data. There was, however, a high degree of variation (Fig. 1), which is to be expected, since we simulated 5000 different epidemics, while the original publication analyzed regional variations in field data from one and the same epidemic (Hutber et al. 2006).

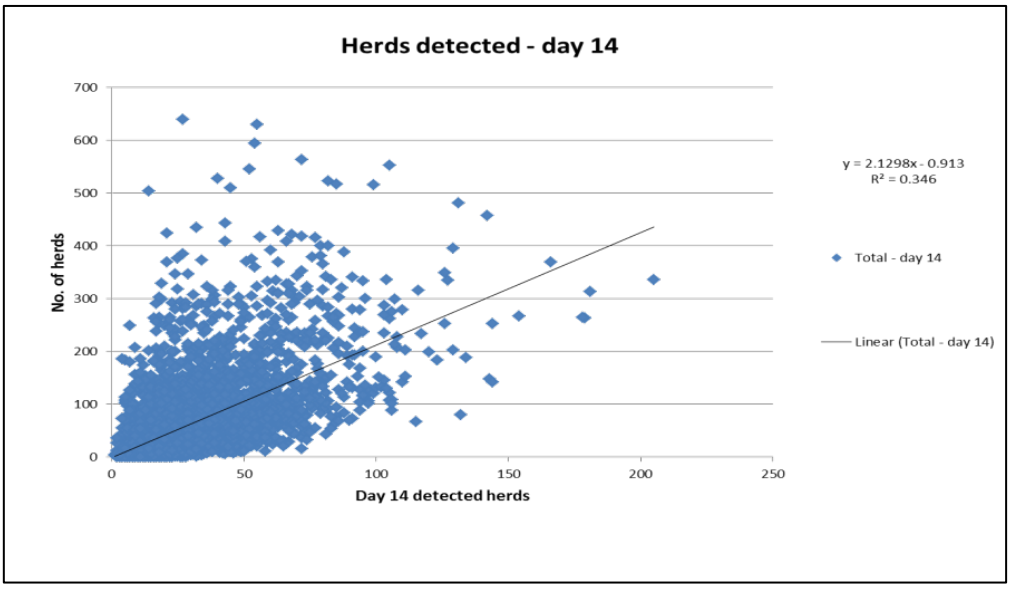

Figure 1. The total number of detected herds after day 14 plotted against the number of affected herds after day 14. Data from the 4,471 of 5,000 simulations, that lasted more than 14 days.

We also simplified the presentation of the results for operational use during a potential outbreak, using a 2-by-2 table format to estimate predictive values by applying selected cut-off- values for both the dependent and the independent variables (Table 1).

Table 1. Sensitivity, specificity and predictive values (p.v.) from one basic control scenario using a combination of cut-off-values of 20 detected herds at day 14 and 100 detected herds at the end of the epidemics. Data from the 4,471 of 5,000 simulations, that lasted more than 14 days.

Scenario A		Subsequent period		
		<100 herds	=>100 herds	Total
Day 14	=<20 herds	1904	102	2006
	>20 herds	1742	723	2465
	Total	3646	825	4471

Sensitivity	0.88
Specificity	0.52
Neg. p.v.	0.95
Pos. p.v.	0.29

Emergency vaccination should be considered during an outbreak if the predicted cumulative size, duration or cost of the epidemic appears alarming (EU 2003, Kitching et al. 2005, Hagerman et al. 2010). The overall results from our project support this conclusion when comparing the expected outcomes from applying the basic control measures, emergency vaccination after day 14 and zonal culling after day 14, respectively (Boklund et al., in prep.)

Conclusion: Our results indicate that predicting the final outcome of an epidemic from the number of outbreaks by day 14 and modifications hereof might be useful in informing decisions two weeks into the epidemic about the potential introduction of control strategies based on emergency vaccination or zonal culling.

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